

57. (Original claim) The method of claim 48, wherein the one or more sensors are three accelerometers disposed to provide three orthogonal axes of sensitivity.

58. (Original claim) The method of claim 48, wherein the one or more sensors are MEMS accelerometers.

59. (Original claim) The method of claim 48, wherein the sensor assembly further comprises a cap coupled to the housing, the cap having a feedthrough for providing conductor access to the one or more seismic sensors, the method further comprising sealing the cap and housing to form a sealed sensor module.

60. (Original claim) The method of claim 59, wherein the sealed sensor module is hermetically sealed.

REMARKS

Claims 1 -60 are pending in the application. Claims 1-60 stand rejected. The abstract of the invention is amended and the description is amended. Claims 27 and 30 are amended and claims 29 and 31 are cancelled without prejudice. No new matter has been added.

The Abstract is amended to remove "The present invention provides", to which the Examiner objected as being redundant. The description is amended to correct a clerical error by changing reference numeral "116" on line 9 of page 7 to correctly read "114" for referring to a module cap.

Independent claim 27 is amended to include limitations of cancelled dependent claims and to correct a clerical error by deleting the word “and” inadvertently placed at the end of the element limitation.

Dependent claim 30 is amended to properly depend from claim 27, rather than from cancelled claim 29.

Claims 29 and 31 are cancelled.

Applicant respectfully submits the following arguments traversing the rejections. The rejections are addressed in substantially the same order as presented in the office action.

35 USC § 102 REJECTIONS

Claims 1-3, 5, 9, 48, 50, 52, 56, and 59 stand rejected under 35 USC § 102(b) as being anticipated by *Crump et al.* (US 3,911,388). Applicant respectfully submits that the Examiner has not presented a prima facie case for anticipation.

Claim 1 is an independent claim that includes the limitation “at least one isolator coupled to the one or more seismic sensors for isolating the one or more seismic sensors from high-g shock induced in the housing.” Claim 48 is an independent method claim for isolating a seismic sensor from high-G shock loads, the claim including the limitation “providing at least one isolator between the one or more sensors and the housing.”

In rejecting the claims, the Examiner cites the ‘388 reference as teaching a housing (Fig. 3, Item 41), a sensor (Fig. 3, Item 51) disposed in the housing, and at least one isolator (Fig. 4, Items 109 and 111) coupled to the sensors for isolating the sensors from high-g shock induced in the housing. The Examiner refers Applicant to columns 3 and 7 for further teachings.

Applicant has thoroughly reviewed the cited reference, and cannot agree with the Examiner’s reading of the ‘388 reference. Referring to Figures 3 and 4 and to the description, the ‘388 clearly teaches an accelerometer unit 51 inside housing 41, which fits snugly but without binding around the curved sides of the unit 51. See column 4, lines 57-

61. Since the housing 41 is fitted snugly about the accelerometer 51, then the accelerometer 51 cannot be isolated from high-g shock induced in the housing 41 as suggested by the examiner, because vibrations induced in the housing are transferred to the accelerometer 51.

The '388 reference teaches in column 5, lines 23 through 30 a seismic mass in the form of a spherical ball 103. The ball contacts the centers of piezoelectric crystals 95, 97 at center points, and the ball 103 is held in place by rubber rings 109, 111. In column 5, lines 5 through 23 that the crystals 95, 97 are cemented to springs 91, 93 and the springs are mounted on an inner case of the accelerometer unit 51. The reference, further teaches that the rings 109, 111 form part of the springs 91,93. Therefore, the rings form part of the spring-mass portion of the sensor 51, and it would be incorrect to conclude that the rings 109, 111 isolate the sensor 51 from vibrations as the rings perform a necessary function of the sensor.

Moreover, nowhere in the '388 reference is there a teaching of isolating the accelerometer 51 from high-g shock induced in the housing 41. Although The Examiner refers Applicant to portions teaching that the rings 109, 111 provide damping at high frequencies, damping high-frequency is not descriptive nor a teaching of high-g shock, which is a mechanical shock characterized by a large amplitude (over 1-G) and short period duration. See Applicant's description at page 3 lines 11-19.

The '388 reference teaches that the rings 109, 111 "contribute to ruggedness of the unit." The '388 reference however, fails to describe how the rings contribute to the ruggedness of the unit. Since the stated functions of the rings are 1) to hold the mass 103 in place and 2) to damp high frequencies. Since there is no mention of isolating the unit from high-g shock, it is an unreasonable conclusion that "contributing to ruggedness of the unit" means to isolate a sensor from high-g shock induced in a housing.

For a prior art reference to anticipate a claim, the reference must include each and every element of the claim. Here, *Crump et al.* reference does not teach or suggest using an isolator to isolate a sensor from high-g shock induced in a housing. Moreover, no single reference of record taken alone or in combination with other references teaches or suggests the claimed invention. Accordingly, Applicant respectfully submits that independent claims 1 and 48 are not anticipated by *Crump et al.* or by any other reference

of record. Applicant respectfully submits that independent claim 1 and independent claim 48 are allowable over the art of record.

Rejected claims 2-3, 5, 9, and 12 depend from claim 1, and rejected claims 50, 52, 56 and 59 depend from claim 48. These dependent claims necessarily include each and every limitation of the corresponding independent claim. Consequently, Applicant respectfully submits that claims 2-3, 5, 9, 12, 50, 52, 56 and 59 are allowable over the art of record for at least the same reasons as stated above for the corresponding independent claims.

35 USC § 103 REJECTIONS

Claims 4, 6, 7, 51, 53 and 54 stand rejected under 35 USC § 103(a) as being unpatentable over *Crump et al.* (US 3,911,388) in view of *Carpenter et al.* (US 5,463,193). Applicant respectfully submits that the Examiner has not presented a prima facie case for obviousness.

Rejected claims 4, 6, and 7 depend from claim 1, and rejected claims 51, 53, and 54 depend from claim 48. These dependent claims necessarily include each and every limitation of the corresponding independent claim. The independent claims are discussed above, and Applicant has shown that the '388 reference does not teach using an isolator to isolate a sensor from high-g shock induced in a housing. Consequently, Applicant respectfully submits that dependent claims 4, 6, 7, 51, 53 and 54 are allowable over the art of record for at least the same reasons as stated above for the corresponding independent claims.

The Examiner takes Official Notice that it is well known in the art to employ silicone rubber and polyurethane foam as vibration dampers as disclosed by *Crump et al.* and *Carpenter et al.* The Examiner concludes that it would have been obvious to those skilled in the art to employ a vibration isolator comprising the materials alone or in combination to increase the vibration damping effect.

Carpenter et al. teaches a vibration isolation module for a towed acoustic streamer to minimize vibrations transmission of mechanical vibration from a tow cable to an acoustic array. Applicant respectfully submits, as discussed above, that damping vibrations completely different than isolating a component from high-g shock as claimed.

Additionally, there is no teaching in the cited art of isolating from high-g shock. The vibrations addressed by Carpenter et al. are operation vibrations encountered while towing an array. Consequently, it is improper to use these references and any Official Notice taken therefrom to conclude that the application of the materials to isolating a component from high-g shock is obvious.

Claims 8, 14-16, 18, 20, 24-28, 32-35, 37, 39, 45-47, 49, 55 and 60 stand rejected under 35 USC § 103(a) as being unpatentable over *Crump et al.* (US 3,911,388) in view of *Hall Jr.* (US 4, 163, 206).

As to claims 8, 14, 49, 55 and 60, these claims depend from claims 1 and 48 discussed above. Applicant has shown that the '388 reference does not teach using an isolator to isolate a sensor from high-g shock induced in a housing. And, the '206 reference does not provide the teaching. Therefore, Applicant submits that dependent claims 8, 14, 49, 55 and 60 are allowable over the art of record for at least the same reasons as stated for the independent claims 1 and 48.

The remaining rejected claims include independent claims 15, 27 and 35. Rejected claims 16, 18, 20, and 24-26 depend from claim 15; 28 and 32-34 depend from claim 27; and 37, 39 and 45-47 depend from claim 35.

Independent claim 15 includes the limitation of at least one isolator coupled to a sensor assembly and to a module case. The '388 reference does not teach an isolator coupled to a sensor assembly and to a module case. As discussed above, the rings concluded by the Examiner to be isolators, do not in fact isolate a sensor assembly. The rings form part of a spring, but the ball 103 contacts crystals and the springs form part of the accelerometer sensor 51 and perform an integral sensing function and not an isolation function. Applicant respectfully submits that independent claim 15 is allowable for the art of record, because the limitation of at least one isolator coupled to a sensor assembly and to a module case is not taught or suggested by any single reference or combination of references of record.

Rejected claims 16, 18, 20, and 24-26 depend from claim 15. These dependent claims necessarily include each and every limitation of the corresponding independent claim. Applicant has shown that the '388 reference does not teach an isolator coupled to a sensor assembly and to a module case. Consequently, Applicant respectfully submits

that dependent claims 16, 18, 20, and 24-26 are allowable over the art of record for at least the same reasons as stated above for independent claim 15.

Independent claim 27 is amended to include the limitation at least one MEMS accelerometer in the independent claim. Thus, independent claim 27 claims a seismic sensor module including at least one MEMS accelerometer and an inertial mass for reducing noise in the sensor module. The combination of the '388 and '206 references does not teach these limitations as arranged in the claim.

U.S. patent 6,315,062B1 to Alft et al. Teaches multi-axis MEMS accelerometers for use in a navigation system in a drilling tool. There is no suggestion in the '062 reference to use a MEMS accelerometer as a seismic sensor. Consequently, those skilled in the art of seismic prospecting would not use the teaching of the '062 drilling navigational tool to solve a problem in sensing seismic waves in the earth. Therefore Applicant submits that independent claim 27, as amended, is allowable over all art of record.

Dependent claims 28 and 32-34 depend from amended claim 27. Applicant respectfully submits that these dependent claims are allowable over the art of record for at least the same reasons as stated for amended claim 27.

As to claims 35, 37, 39 and 45-47, Applicant respectfully submits that the Examiner has failed to present a prima facie case of obviousness. Independent claim 35 includes the limitation of "an isolation layer coupled to the module case and to the sensor assembly, wherein the sensor assembly does not move relative to the module case when an input force of less than a predetermined level is applied to the module case."

The '388 reference has been discussed in detail. There is no teaching in the '388 reference of an "isolation layer." The rings 109, 111 taught by the '388 reference do not isolate the sensor 51 as suggested by the Examiner, because the rings form part of the sensor 51 and perform part of the spring function. Moreover, the rings '388 do not constitute a "layer", because the rings allow the mass 103 to contact the crystals 95, 97.

The Hall reference is cited for its teaching of an inertial mass, and Applicant cannot find a teaching of an isolation layer in the reference. Thus, the combination of Hall and Crump et al. does not teach all the limitations of claim 35 as arranged in the claims. Therefore, Applicant submits that independent claim 35 is allowable over the art of record.

Rejected claims 37, 39, and 45-47 depend from independent claim 35. Applicant

respectfully submits that these dependent claims are allowable for at least the same reasons as stated for claim 35.

Claims 10, 11, 57 and 58 stand rejected under 35 USC § 103(a) as being unpatentable over *Crump et al.* (US 3,911,388) in view of *Alft et al.* (US 6,315,062).

The '388 reference has been discussed extensively above. Claims 10 and 11 depend from claim 1 discussed above and claims 57 and 58 depend from claim 48 discussed above. The '062 reference teaches a drilling tool with a navigation system employing multi-axis MEMS accelerometers as part of the navigation system. Applicant can find no discussion of seismic prospecting sensors using MEMS accelerometers in '062, nor does Applicant find a teaching of using an isolator to isolate a MEMS accelerometer from high-g shock. Thus, the combination of '388 and '062 does not teach every element of the rejected claims. Consequently, Applicant respectfully submits that claims 10, 11, 57 and 58 are allowable over the art of record.

Claims 17, 23, 29-31 and 42-44 stand rejected under 35 USC § 103(a) as being unpatentable over *Crump et al.* (US 3,911,388) in view of *Hall Jr.* (US 4, 163, 206) and further in view of *Alft et al.* (US 6,315,062).

Claims 17 and 23 depend from independent claim 15 discussed above, claims 29-31 depend from amended claim 27 discussed above and claims 42-44 depend from independent claim 35 discussed above. Applicant respectfully submits that these dependent claims are allowable for at least the same reasons as discussed above in reference to the independent claims. The combination of references do not teach every element of the independent claim, namely the isolation limitation discussed above. Moreover, Applicant has discussed above that the '062 reference does not teach or suggest MEMS accelerometers for use in seismic sensors, and there is no suggestion in any reference to combine the drilling tool navigation system sensor in '062 with the teaching of '388 or '206 Hall or Crump.

Claims 19, 21, 22, 38, 40 and 41 stand rejected under 35 USC § 103(a) as being unpatentable over *Crump et al.* (US 3,911,388) in view of *Hall Jr.* (US 4,163,206) and further in view of *Carpenter et al.* (US 5,463,193).

Claims 19, 21 and 22 depend from independent claim 15 discussed above, and claims 38, 40 and 41 depend from independent claim 35 discussed above. Applicant

respectfully submits that the dependent claims are allowable for at least the same reasons as stated for the associated independent claim.

Crump does not teach the isolator as claimed in claims 1 and 15, and neither Hall Jr. nor Carpenter et al. teach the claimed isolator. With respect to the claims rejected over the combination, Applicant reiterates that Carpenter et al. deal with a completely different vibration problem, i.e., mechanical vibration in a towed array induced through a tow cable. Therefore, the '193 reference fails to teach seismic sensor module tolerant to high-g shock inputs as claimed in either claim 15 or 35. Therefore, Applicant submits that claims 19, 21, 22, 38, 40 and 41 are all allowable over the suggested combination of the '388, 206, and '193 references.

CONCLUSION

For all of the foregoing reasons, applicant submits that the claims are allowable over the prior art of record. A check for the petition for an extension of time is submitted herewith, and no other fee is believed due for filing this response. The Commissioner is hereby authorized to charge any additional fee due for this response or credit any overpayment to Deposit Account No. 13-0010 (IO-1058US).

Respectfully submitted,

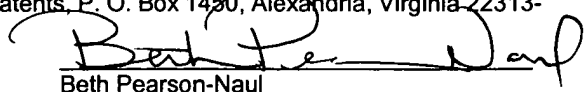
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EXPRESS MAIL CERTIFICATE

I hereby certify that this paper or fee, along with any papers referred to as being attached or enclosed is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 CFR 1.10, Express Mail Label No. EV322404345US, on May 27, 2003, Commissioner for Patents, P. O. Box 1450, Alexandria, Virginia 22313-1450.


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